WOLF CREEK
NUCLEAR OPERATING CORPORATION

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ET 06-0058

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

References: 1) Letter ET 06-0010, dated March 2, 2006, from T. J. Garrett, WCNOC, to USNRC

2) Letter ET 06-0043, dated October 5, 2006, from T. J. Garrett, WCNOC, to USNRC

Subject: Docket No. 50-482: Wolf Creek Nuclear Operating Corporation's Response to the Second NRC Request for Additional Information Regarding 10 CFR 50.55a Request I3R-01

Gentlemen:

Reference 1 provided Wolf Creek Nuclear Operating Corporation (WCNOC) 10 CFR 50.55a Requests I3R-01 and I3R-02, which requested alternatives to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (BPV) Code, Section XI for inservice inspection (ISI) and testing for the Third Ten-Year Interval of WCNOC's ISI Program. Reference 2 provided WCNOC's response to a Nuclear Regulatory Commission (NRC) request for additional information (RAI) regarding 10 CFR 50.55a Request I3R-01.

On November 21, 2006, the NRC Project Manager for WCNOC provided by electronic mail a second RAI regarding 10 CFR 50.55a Request I3R-01. A follow-up phone call between NRC and WCNOC staff was conducted on November 29, 2006 to further clarify the information the NRC was seeking from WCNOC with regard to the November 21, 2006 RAI.

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The Attachment to this letter provides WCNOC's response to the second RAI. It lists the NRC question followed by WCNOC's response to the question.

There are no commitments associated with this submittal. If you have any questions concerning this matter, please contact me at (620) 364-4084, or Mr. Kevin Moles at (620) 364-4126.

Very truly yours,

Patrick Fluery
for T. J. Garrett

Terry J. Garrett

TJG/rlt

Attachment

cc: J. N. Donohew (NRC), w/a
B. S. Mallett (NRC), w/a
G. B. Miller (NRC), w/a
Senior Resident Inspector (NRC), w/a

Wolf Creek Nuclear Operating Corporation (WCNOC) Response to Second NRC Request for Additional Information (RAI) Regarding 10 CFR 50.55a (Relief) Request I3R-01

NRC Question:

For the re-evaluation performed to account for the 147 additional auxiliary feedwater line welds, discuss to what level external events (including internal fire), indirect (spatial) effects, and shutdown were analyzed (i.e., qualitative or quantitative) and whether there was any impact on the consequence/risk results.

WCNOC Response:

Following is a discussion of the delta risk determination for the 126 Auxiliary Feedwater (AL) System welds and the 21 Main Feedwater (AE) System welds added to the Risk Informed – Inservice Inspection (RI-ISI) program.

Main Feedwater (AE) System Welds

The Conditional Core Damage Probability (CCDP) utilized for the delta risk determination for the 21 AE system welds is a HIGH consequence value of 1.44E-02. A break at any of these welds results in delivery of harsh environment main feedwater inventory into areas containing equipment that is not qualified for a harsh environment. Worst case assumptions of equipment lost results in a loss of feedwater supply to all four steam generators from either the AE system or from the AL system. In addition, one or more Steam Generator Atmospheric Relief Valves (ARVs) are assumed to fail to the open position. The only mechanism available for decay heat removal is feed and bleed. The CCDP value of 1.44E-02 essentially represents the failure probability for the feed and bleed function.

Main Feedwater (AE) System Welds With Degradation Mechanism

For the 21 AE system welds, 17 have a Degradation Mechanism (DM), while 4 welds have no DM. From the EPRI RI-ISI methodology, the failure frequency for a weld with a DM is 2.0E-07/yr. The failure frequency for a weld with no DM is 1.0E-08/yr.

The delta risk determination utilizes the following equation from the EPRI RI-ISI methodology:

$$\Delta CDF_j = F_{oj} * CCDP_j * \Delta POD_j \qquad \text{Equation (1)}$$

Where:

ΔCDF_j = the change in core damage frequency risk at weld location "j"

F_{oj} = frequency of pipe rupture at location "j" subject to no inspection

$CCDP_j$ = conditional core damage probability due to a pipe rupture at location "j"

ΔPOD_j = the change in the probability of detection of a flaw by inspection at weld location "j"

The delta POD (probability of detection) from the EPRI RI-ISI methodology is determined by:

$$\Delta POD_j = (1 - POD_{rj}) - (1 - POD_{ej}) \qquad \text{Equation (2)}$$

Where:

POD_{rj} = the probability of detection of a flaw in a weld by inspection in the risk informed program

POD_{ej} = the probability of detection of a flaw in a weld by inspection in the existing program

Also from the EPRI methodology:

For welds with a DM of thermal fatigue in the existing inspection program, use a POD of 0.3.

For welds with a DM of thermal fatigue in the RI-ISI program, use a POD of 0.9.

For all other welds being inspected, use a POD of 0.5.

For welds not being inspected, the POD is zero.

For the 17 AE system welds with a DM of thermal fatigue, 2 of 17 welds were already being inspected under an existing program.

Applying equation (2), and then equation (1), above for the these 2 welds:

$$\Delta POD_j = (1 - 0.9) - (1 - 0.3)$$

$$\Delta POD_j = -0.6$$

$$\Delta CDF = (2 \text{ welds}) * (2.0E\text{-}07/yr) * (1.44E\text{-}02) * (-0.6)$$

$$\Delta CDF = -3.46E\text{-}09$$

For the 17 AE system welds with a DM of thermal fatigue, 6 welds were selected for the RI-ISI program which were not already being inspected under an existing program.

Applying equation (2), and then equation (1), above for the these 6 welds:

$$\Delta POD_j = (1 - 0.9) - (1 - 0)$$

$$\Delta POD_j = -0.9$$

$$\Delta CDF = (6 \text{ welds}) * (2.0E\text{-}07/yr) * (1.44E\text{-}02) * (-0.9)$$

$$\Delta CDF = -1.56E\text{-}08$$

The remaining 9 AE system welds with a DM were not being inspected previously, and are not being inspected under the RI-ISI program, so the ΔCDF for these welds is zero.

Main Feedwater (AE) System Welds With No Degradation Mechanism

For the four AE system welds with no DM, one weld was being inspected under an existing program, and one weld has been selected for the RI-ISI program. For the weld selected for inspection, the ΔPOD would be zero so the ΔCDF would be zero. The remaining 3 AE system welds with no DM were not being inspected previously, and are not being inspected under the RI-ISI program, so the ΔCDF for these welds is zero.

Total ΔCDF for AE System Welds

The total ΔCDF for the 21 AE system welds being included in the RI-ISI program is:

$$\Delta CDF = (-3.46E\text{-}09) + (-1.56E\text{-}08)$$

$$\Delta CDF = -1.90E\text{-}08$$

The delta Large Early Release Frequency (LERF) values are determined in a similar manner to the ΔCDF and result in a value one order of magnitude less:

$$\Delta LERF = -1.90E\text{-}09$$

Auxiliary Feedwater (AL) System Welds

The CCDP utilized for the delta risk determination for the 126 AL system welds is a MEDIUM consequence value for all welds. None of the AL system welds was determined to have an applicable DM. The CCDP at a particular weld location is determined based on the components lost due to spatial considerations and due to losses of system function. Depending on the break location, one or more check valves would also have to fail. The CCDP for weld breaks upstream of the Main Feedwater/Auxiliary Feedwater System boundary check valve, is 6.82E-05 (Conditional Large Early Release Probability (CLERP) is 6.82E-06). For welds further upstream of a second check valve, the CCDP is determined to be 8.98E-06 (CLERP is 8.98E-07).

Both of these CCDP values are in the MEDIUM consequence range. For determination of ΔCDF, the maximum CCDP for the MEDIUM consequence range of 1.0E-04 was conservatively applied.

No AL system welds were selected for the RI-ISI program. No AL system welds were being inspected under any existing program, so the actual ΔCDF realized would in fact be zero. However, ASME Code Section XI, Table IWC-2500, Category C-F-2 would require that 7.5 percent of these Class 2 welds be inspected if they were to remain under the ASME inspection program. Therefore, under an ASME inspection program, ten AL system welds would be selected for inspection. The ΔCDF was determined assuming that ten AL system welds were being inspected under an existing inspection program, but are not being inspected under the RI-ISI program.

Again, applying equation (2), and then equation (1), above for these ten AL system welds:

$$\Delta POD_j = (1 - 0) - (1 - 0.5)$$

$$\Delta POD_j = 0.5$$

$$\Delta CDF = (10 \text{ welds}) * (1.0E\text{-}08/yr) * (1.00E\text{-}04) * (0.5)$$

$$\Delta CDF = 5.0E\text{-}12$$

The ΔLERF values are determined in a similar manner to the ΔCDF and result in a value one order of magnitude less:

$$\Delta LERF = 5.0E\text{-}13$$

The remaining 116 AL system welds were not being inspected previously, and are not being inspected under the RI-ISI program, so the ΔCDF for these welds is zero.

Overall Delta CDF Impact For Added AE and AL System Welds

For all 147 AE and AL system welds added to the RI-ISI program, a net reduction in ΔCDF of 1.89E-08 (-1.90E-08 + 5.0E-12) is realized.

External Events Consideration

External events were considered on a qualitative basis for the AE and AL system line welds. It was considered that the likelihood of a line break occurring for at-power operation concurrent with occurrence of an external event is extremely small.

If quantitative inclusion of external events results in a small increase in CCDP, for the AE system welds this would result in a further reduction in ΔCDF. An increase in CCDP for the AE system welds would result in a reduction in ΔCDF since six additional welds were selected for inspection in the RI-ISI program that were not previously being inspected.

For the AL system welds, a small increase in CCDP due to inclusion of external events is considered enveloped by utilization of the maximum MEDIUM consequence CCDP value of 1.0E-04 when determining ΔCDF. In the unlikely event that inclusion of external events were to result in an increase in CCDP for the AL system welds that moved them into the HIGH consequence category, the overall impact on ΔCDF would still remain well within the acceptance criteria of less than or equal to 1.0E-07/year per system. If the maximum HIGH consequence CCDP value were applied for the AL system, the ΔCDF would be:

$$\Delta CDF = (10 \text{ welds}) * (1.0E\text{-}08/yr) * (1.44E\text{-}02) * (0.5)$$

$$\Delta CDF = 7.2E\text{-}10$$

Inclusion of external events on a quantitative basis would not change the evaluated risk characterization for the AE or AL system line welds added to the RI-ISI program.

Shutdown Modes Consideration

For shutdown modes of operation, decay heat removal is primarily via the Residual Heat Removal (RHR) System. In certain shutdown modes Plant Operating States (POSs), reflux cooling using the steam generators may be utilized for cooling if RHR cooling is lost. The AL system provides one possible source of inventory to the secondary side of the steam generators. Other sources of inventory supply to the secondary side of the steam generators include the Essential Service Water System and supply from the Fire Protection System.

With a number of possible sources of supply for steam generator secondary side inventory, it is considered unlikely that a break in an AL system supply line to any one steam generator would result in a loss of reflux cooling capability. In addition, the spatial impact resulting from an AL system line break would be less severe in shutdown modes than a break occurring at power. Any AE/AL system inventory released through a break would be low pressure, low temperature fluid which would have considerably less impact than the harsh environment that would follow an at power line break.

On a qualitative basis, the CCDP and delta risk impact due to an AE/AL system line break are expected to be negligible. WCNOC does not have a verified quality shutdown modes PRA model that can be used to quantitatively determine the CCDP for a shutdown modes AE/AL system line break. However, a very limiting upper bound estimate for an AL system line break during shutdown modes is provided:

A limiting assumption was made that an AL system line break would result in a CCDP value of 1.0. Reflux cooling is viable for shutdown modes POSs that make up approximately 50 percent of the time spent in the shutdown modes. Assuming one refueling outage per 18 month cycle with a duration of approximately 30 days, reflux cooling is considered viable for approximately 15 days per 18 month fuel cycle.

Given these limiting assumptions, and using the equation provided above for ΔCDF for the AL system for at power operation:

$$\Delta CDF = (10 \text{ welds}) * (1.0E\text{-}08/yr) * (1.0) * (0.5) * ET$$

Where ET is the exposure time of 15 days per 18 month fuel cycle.

$$ET = [15 \text{ days} / (365 \text{ days} * 1.5)] = 2.74E\text{-}02$$

$$\Delta CDF = 1.37E\text{-}09$$

Combining this very conservative estimate for shutdown modes ΔCDF with the 5.0E-12 ΔCDF for at power, the overall impact on ΔCDF still remains well within the acceptance criteria of less than or equal to 1.0E-07/year per system.